The Effect of Intentionally Engaging Attention when Viewing Restorative Environments: Exploring Attention Restoration Theory

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ABSTRACT

Although research exploring Attention Restoration Theory has been extensive, certain procedures for its study seem to be taken as implicit, but require investigation for a deeper understanding and application of both the theory and its underlying processes. This study aimed to answer the questions: "What is the result of engaging directed attention when viewing otherwise restorative environments?" and "Does this intentional engagement have any effect on already fatiguing non-restorative environments?" Participants were asked to complete a task designed to fatigue their directed attentional capacity and then view images of restorative or non-restorative environments, wherein they either were asked to direct their attention to these environments, or were allowed to view them freely. Those viewing restorative environments but asked to direct their attention had significantly lower and even inhibited recovery from Directed Attention Fatigue than participants viewing these environments freely. Additional analyses explored this effect between environments and on a number of subjective measures. Discussion focuses on the role of tasks in the restorative process and the seemingly inherent neutrality or facility of different environments in regards to restoration.

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The Effect of Intentionally Engaging Attention when Viewing Restorative Environments: Exploring Attention Restoration Theory

The idea that nature provides a forum for psychological, physiological, and even spiritual restoration is one that most would support without empirical evidence. A simple observation from the perspective of a park bench on a sun-filled spring afternoon reveals a seemingly inherent need in humans to experience nature – even simple, everyday nature. In examining aspects of this experience, psychological studies have attempted to answer why this need exists and what motivates individuals to seek out natural settings over more urban, built environments. These questions are most frequently answered in terms of the recovery of physical and mental resources, which is facilitated by exposure to the natural environment.

The belief that nature holds restorative power is evident in a broad array of disciplines. Theorists in religion, poetry, art, philosophy, and architecture have all independently identified nature as a source of restoration. The Hebrew Scriptures, for instance, tell of *Yahweh*'s provision of nature as a restorative medium: "He makes me to lie down in green pastures. He leads me beside quiet waters. He restores my soul…" (Psalm 23:2-3, New American Standard Bible). Thoreau, by immersing himself in Nature, reported experiencing a soothing calm, even in the roar of a storm (Thoreau, 1992, p.89). Architecture often attempts to replicate and "belong" to nature through design, as alluded to by the father of organic architecture, Frank Lloyd Wright: "No house should ever be on a hill or on anything. It should be of the hill. Belonging to it" (Wright, 1932). This philosophy breaks down the built-environment/natural environment barrier allowing for the notion that even built structures can foster restoration.

Nature's restorative benefits, while seemingly connected through an inherent ethereal quality of environments, in fact have been extensively empirically studied, qualified, and quantified. This study reviewed research concerning the relationship between natural

environments and psychological restoration, outlined the current theory explaining this relationship, and attempted to answer the questions: "What is the result of engaging directed attention when viewing otherwise restorative environments?" and "Does this intentional engagement have any effect on the already fatiguing (or, at least, 'neutral') qualities of non-restorative environments?"

Beginnings of Environmental Psychology

Psychological research, in regards to studying the natural environment, has largely attempted to answer the question of why humans seem to prefer natural settings over built environments (with preference being defined in terms of an "expression of underlying human needs" as opposed to a luxury [Kaplan, 1995, p. 10]), particularly when these environments can be dangerous and less controllable. Early research attempting to answer these questions was anecdotal, taking the form of subjective reports by hikers and analyses of journals kept by participants in outdoor programs or backpacking trips (e.g., Kaplan & Talbot, 1983). These reports did, however, provide researchers with a staggering list of psychological benefits experienced in the wilderness. Some of these benefits included relaxation, stress reduction, mindfulness, peace, tranquility, increased sensory awareness, hardiness, sensed presence (the feeling of the presence of an "other"), connectedness, increased pro-environmental attitudes, and Maslowian peak experiences (self-actualization), to name a few (Berman, Jonides, & Kaplan, 2008; Davis, 1998). One of the early studies often referenced is Kaplan and Talbot's (1983) analysis of wilderness journals.

Kaplan and Talbot (1983) analyzed journals that participants in the Outdoor Challenge Research Program (a two-week backpacking excursion through the Michigan wilderness) kept both during their time in the woods as well as their first few days' return to civilization. The analyses yielded an inclusive list of the "psychological dimensions of wilderness experience" (p.

179) as well as insights into what factors differentiate wilderness experiences from experiences in other settings (Kaplan & Talbot, 1983).

From their participants' descriptions, Kaplan and Talbot (1983) identified a set of dimensions that encompassed the common themes found in nature experiences. These dimensions included *situational stress*, induced by the challenging environment in which participants found themselves, overall *enjoyment* of the experience (outlined by feelings of happiness, time to think and physically and mentally feeling "good"), *fascination* (including such simple observations as "the sights were beautiful" and "the sun was warm"), and *perceptual changes* that included heightened awareness, comfort, awe, and self-evaluations. Kaplan and Talbot also acknowledged a category unrelated to other areas that included observations of tranquility, privacy, and the feeling of overcoming personal fears. Furthermore, the researchers noted journals that included entries after participants returned to society ("reentry" journals) contained many expressions of negativity toward the civilized environment. After their time in nature, participants saw in their built environments "ugliness, artificiality, unnecessary urgency, and [even] superficiality in their friendships" (Kaplan & Talbot, 1983, p. 184). They reported fond memories of their wilderness experience and reported their new perceptions as being better or higher than those they previously held.

These results presented an obvious contrast between exposure to natural and built settings: Whereas exposure to the natural environment seemed to be an overall positive, restorative experience, exposure to urban environments seemed at odds with psychological restoration. The question was then, what underlying cognitive processes could account for this preference and drive to seek out "restorative" environments – in other words, what needed restoring? For several years following, research into this question was divided into two camps:

the drive to reduce stress versus the drive to recover lost attentional capacity (Hartig & Evans, 1993).

In 1973, Roger S. Ulrich completed his dissertation (that explored route preference during shopping trips; economical and uninteresting versus delayed and scenic routes), initiating what would be a body of work that explores the psychological and physiological effects of landscapes. Ulrich (1983) provided a summary of this early research and argued that human preference for natural over built environments could be understood in the context of the affect-arousal relationship. "The theoretical position here is that feelings, not thoughts, come first in environmental encounters, and the observer's initial feeling reaction shapes subsequent cognitive events" (p. 117). Ulrich did argue that initial arousal state affects the restorative potential of an environment (an idea that is important when exploring S. Kaplan's work) and illustrated the power of this person-environment interaction in his groundbreaking 1984 study of surgery patients.

Ulrich (1984) examined outcomes of individuals recovering from gallbladder surgery. The patients differed only in the type of view from their inpatient room, yet the results showed that patients whose rooms had a more natural view were found to request weaker pain medication, spend less time in the hospital post-surgery, and were less likely to be reported as problematic by the medical staff when compared to those with an uninteresting, built view. This cohort was chosen in part because they represented those in an unusually high initial arousal (i.e. stress) state, providing a clear example of the positive psychophysiological effects of viewing even "simple, everyday nature." Ulrich also noted that the stress-reducing qualities of natural environments seemed to "foster restoration" as opposed to simply being the result of a restorative experience (1984, p. 420), but his work left many questions remaining and presented the field with a multitude of directions for future research (Ulrich, 1983).

During this same period, S. Kaplan and others were following up on the research stemming from the Outdoor Challenge Program and began to question the role mental fatigue played in the drive to seek out restorative environments. In a presentation to the Environmental Design and Research Association (EDRA) in 1987, S. Kaplan drew upon work in the restorative effects of gardening (R. Kaplan, 1973), preference for different environments (Herzog, 1984, 1985, 1987; Herzog, Kaplan, & Kaplan, 1976, 1982), vigilance (Warm, 1984; Warm & Dember, 1986), and attentional fatigue (e.g., Cohen & Spacapan, 1978, among others) to suggest a relationship between fatigued cognitive functioning and environmental design. He argued that wayfinding (i.e., navigation), "making and carrying out plans," and interacting socially are cognitively costly in built environments where overstimulation forces humans to choose among competing stimuli, inhibiting that which is not critical to the task at hand. Kaplan believed an underlying component of attention must be allowing for these functions to work properly, but specifics regarding the nature of such a resource would have to be gleaned from the body of work investigating attention.

Attention

The study of attention in and of itself is anything but straightforward. As both an individualistic cognitive process and a facilitator of other cognitive processes, its study can be convoluted and terribly confounded. Even attempting to define the concept can be a cyclical process, with many often choosing to encapsulate attention as "paying attention to something", which makes attention appear to be a costly or transferrable process – an idea that will be explored further later. Certainly William James (1892) provided a perfectly apt definition in referring to attention as "the narrowness of consciousness" (p. 217). James understood that the sum of our sensory experience at any given moment is beyond what we can completely interpret so attention, therefore, is largely at the mercy of our 'interests'. He noted that attention can be

directed toward objects that are actually sensed in a physical way or toward "ideal or represented objects" (p.221). In either case, James states attention is either immediate (directly interesting) or derived (interest stemming from some other thing of interest to which the object is related). Additionally, attention can be subdivided into effortless and effortful, with this last category being the primary topic of interest for the present study.

Voluntary attention. When attention requires effort, James noted that it is always the type that can be categorized as deriving its interest from some other related object. He called the effortful attention "active and voluntary" and wrote, "[W]e never make an *effort* to attend to an object except for the sake of some *remote* interest which the effort will serve" and "we [experience voluntary attention] when we *resist the attractions* of more potent stimuli and keep our mind occupied with some object that is naturally unimpressive" (James, 1892, p. 221-224).

This 'voluntary attention' is unique in that it requires effort to maintain, effort in the form of selection between competing stimuli. The main function of the attentional component is to inhibit the stimuli one wishes to ignore in favor of the stimuli to which one wishes to attend. However, this attentional component, being rooted in conscious effort, is recognized as susceptible to fatigue. James (1892) went on to write "there is no such thing as voluntary attention sustained for more than a few seconds at a time … to every man actuated by passion the thought of interests which negate the passion can hardly for more than a fleeting instant stay before the mind" (p. 224-225). When that instant passes and yet the individual still attempts to attend to the uninteresting stimulus, fatigue can set in and the result may be distractibility, irritability, stress, impatience, and impaired judgment, among other negative consequences (Kaplan, 1995). It is this component of attention, effortful and susceptible to fatigue, that was of particular interest to Stephen Kaplan.

Directed attention. Drawing from James' initial concepts of voluntary attention, Kaplan proposed the use of the term "directed attention" to refer to this component, which was more descriptive of then current understandings and terminology used in cortical damage research (Mesulam, 1985, as cited in Kaplan, 1995). Kaplan posited that directed attention facilitates the inhibition of unimportant stimuli (and, therefore, provides for "focus"), noting that "it is this central inhibitory capacity which is assumed to be susceptible to fatigue following extensive use" (Kaplan, 1987, p.57). Kaplan went on to argue that "restorative environments" are those that allow directed attention to rest and largely seemed to consist of "natural" environments. However, he was careful to note that at the time these discussions were largely theoretical and should serve as an opportunity for researchers to test the theories presented therein. Additionally, the ideas presented in this address suggested new definitions and directions for the seemingly concrete realm of attention research and theory.

According to Kaplan (1995), attentional fatigue is a result of the prolonged inhibition of competing stimuli which occurs independent of the amount of potential input in a setting. Fatigue may occur even in a setting relatively sparse in stimuli if one feature requires particular attention. This fatigue may reduce one's ability to select among competing stimuli, resulting in decrements on a variety of problem-solving tasks. Directed Attention Fatigue (DAF) can also affect relationships between perceptual and processing abilities, for instance by increasing distractibility and decreasing contemplative functioning necessary for planning. Ulrich et al. (1991), however, largely rejected these ideas and the role that effortless attention (or *fascination)* played in recovery from mental fatigue arguing, "it seems appropriate to interpret 'mental fatigue' in more mainstream terms as referring to a stress state of varying intensity elicited by work or mental stressors" (p. 207).

The argument between stress-based and attention-based theories accounting for the restorative benefits of nature continued for several years, until in 1995, prompted by Hartig and Evans' 1993 review and call for a synthesis as well as promising new research (e.g., Cimprich 1992 ; Hartig, Mang, & Evans,1991) Kaplan proposed a confluence of the two models in terms of "an integrative framework" he called Attention Restoration Theory (ART).

An Integration of Theories

Hartig and Evans (1993) described the need for a more complete model of the restorative benefits of nature. Their chapter notes that Ulrich and the Kaplans "appear[ed] to treat different aspects of restoration. Ulrich emphasizes immediate psychophysiological recovery from stressful experiences whereas the Kaplans' first concern is with replenishment of attentional capacity following cognitive fatigue, which they differentiate from stress" (p. 450). To address this, S. Kaplan (1995) offered an article entitled "The Restorative Benefits of Nature: Toward an Integrative Framework"

In his integrative framework, Kaplan (1995) argued that the seemingly "conflicting" theories of restorative environments were a result of a misunderstanding or misinterpretation of the human stress reaction. He noted that stress theories were often "too expansive," which could result in theories "so broad and diffuse as to cover everything and explain nothing" (p.178). Kaplan stepped back and divided stress factors into two main categories: harm and resource inadequacy. He then subcategorized harm as direct (physical) and perceptual (indication of threat/forthcoming harm). Applying the same logic to resource inadequacy, Kaplan noted this factor comes from *appraisal* (awareness that resource inadequacy exists through cognitive processes), *intuition* (pre-attentive awareness of inadequacy), and then added a third sub-category which allows for a middle ground between prediction and anticipation. This sub-

category is stress due to resource inadequacy that comes from a *gradual depletion* of an actual resource.

Kaplan argued that the "resource" described in the second half of his stress derivation would have to fit certain criteria. "It would have to be important to the individual's functioning …pervasive in its influence … [and would] have to function like a resource; …subject to depletion and subsequent inadequacy" (p. 178). Directed attention matched these criteria perfectly because of its integral role in processing information and the adaptive need of inhibition. Kaplan then went on to explain that the limitation in the work of Ulrich et al. (1991) was a failure to allow for cognitive processes in the stress response as well as a lack of incorporating the other tenets of Attention Restoration Theory (ART), outside of *fascination*, into the discussion (Kaplan, 1995). He then closed by illustrating how this new understanding of resource inadequacy could explain previously paradoxical outcomes such as the relationship between information processing and attentional fatigue, between enjoyment and exhaustion, phenomenological differences in the stress reaction, and how the same activity can elicit either a stress or pleasurable response at different time-points.

Attention Restoration Theory. Although this new understanding of directed attention and DAF presented exciting directions for research in the field, it also elucidated earlier work into the specific qualities of environments that encourage recovery from mental fatigue.

As previously mentioned, Kaplan and Talbot (1983) outlined the factors necessary for an environment to be restorative. Kaplan and Kaplan (1989) further refined these factors to come to the "four central aspects of restorative settings" (p. 182): *fascination*, *extent* (or coherence), *being away*, and *compatibility*. Attention Restoration Theory (ART) suggests that when present, a combination of these factors may indicate if an environment possesses restorative potential or restoration in the form of recovery from DAF. ART also suggests that natural environments are

particularly adept at fostering restoration because most nature settings exhibit a particularly strong confluence of these attributes.

Fascination seems to demand primary explanation because of its integral role in attention. In order for recovery from DAF to occur, an involuntary, non-inhibitory attentional process must be initiated. This process comes in the form of involuntary attention. Fascination suggests an inherent novelty or captivating quality of a setting that draws our attention without effort (Ulrich et al., 1991). In such a setting we are free to evaluate surroundings without specifically engaging directed attention to inhibit competing stimuli or focus on an object.

It is important to note, however, that fascination can actually deplete attention if the stimulus is too interesting. To account for this, researchers allow for the distinction of hard and soft fascination (e.g., Berto, Baroni, Zainaghi, & Bettella, 2010; Berto, Massaccesi, & Pasini, 2008; Kaplan, 1995; Kaplan & Kaplan, 1989). Hard fascination involves settings which may be natural and high on the other necessary restorative components, but possess qualities that do not foster attentional recovery because of demanding properties (e.g., a roaring waterfall). Soft fascination environments (e.g., an ordinary forest setting with a closed vantage point), on the other hand, possess the correct mix of interesting yet not intensely engaging qualities that allow for effortless attention, and therefore restoration, to occur (Herzog, Black, Fountaine, & Knotts, 1997). The Kaplans (1995) did note, however, the critical relationship between fascination and extent: “Even an extended sequence of fascinating elements, if unrelated to each other, will not engage our process fascinations. Thus fascination and extent are mutually supportive” (p.185).

It is logical, then, to next discuss the necessity of an environment to allow for certain levels of *extent* to be experienced. The extent or coherence component of restorative environments involves a sense of connectedness, often referred to as “sensed presence”, or even the spirituality of place. Kaplan and Kaplan (1989) explain that extent occurs when the

individual recognizes the interconnectedness of a place as comprising some larger whole. This recognition can be manifested as practical and physical, in terms of wayfinding and creating a mental map of an area; yet it can also be more conceptual or even "spiritual" in terms of the recognition or "continuation of the world beyond what is immediately perceived" (Kaplan & Kaplan 1989, p.190). The implication here is that, cognitively, most daily human focus – particularly in the developed world – is particularly myopic. Restorative settings permit an opportunity to see beyond the minutia and contemplate an interconnectedness that, as "cognitive misers" (Fiske & Taylor, 1984), we often neglect.

The third component of restorative environments is often the one that is referenced most by laypeople. *Being away* refers to an opportunity for escape from the familiar or monotonous. The Kaplans (1989) described how individuals often report needing to "get away from it all" or "walk away" from a stressful project. In this sense, what they are searching for is often termed an "escape", which can take three forms: escape from distraction, escape from certain content or anything that might remind them of that content (e.g., work), and sometimes even escape from any sort of mental effort. Natural environments are said to provide a sense of reprieve from other attention demanding settings – akin to a cognitive vacation – yet "being away" does not have to deal with physical distance at all but rather conceptual distance. Certainly a number of studies, covered in more detail later, deal with nearby nature, even gardens, as an escape (e.g., Faber Taylor & Kuo. 2009; Faber Taylor, Kuo, & Sullivan, 2002; Felsten, 2009; R. Kaplan, 1973, 1983, 1985, 2001; S. Kaplan, 2001; Kuo, & Sullivan, 2001; Ranaas, Evensen, & Rich, 2011; Shibata & Suzuki, 2001; Tennessen & Cimprich, 1995; Trougakos, Beal, Green, & Weiss, 2008; Ulrich 1984; Unruh, Smith, & Scammell, 2000; Wells & Evans, 2003).

The final component, *compatibility*, deals with the degree to which a setting matches the individual's inclinations and motivations. Kaplan (1995) suggests this component has a powerful

hold, perhaps rooted in evolution, but the evolutionary drives are not always met (e.g., drive to hunt and gather). Compatibility does not, necessarily, initiate actions, but the setting must facilitate the actions desired by the observer by means of providing the information necessary for action. Although this component can be somewhat confusing, Kaplan and Kaplan (1989) give an example in terms of attempting to navigate while driving. If the environment is compatible with this task, then the most captivating pieces of information, perceptually, will be the road signs that will lead one to their destination. However, in an incompatible environment, billboard advertising, homes, people, etc. all may be more interesting so to attend to the information necessary to navigate, these pieces of information must be inhibited. It is easy to see, then, how directed attention must be engaged in incompatible settings and, therefore, why compatibility is necessary for an environment to be restorative (Kaplan & Kaplan, 1989).

It is important to reiterate that more recent research has confirmed the Kaplans'(1989) initial assertion that these components do not work in a binary fashion, but rather their combinations yield different levels of restorative potential and are, naturally, dependent upon the specifics of the environment (Herzog et al., 1997). Also, the restorative experience itself is not always the same and is dependent upon the environment's quality and duration of the exposure. Kaplan and Kaplan (1989) wrote that the restorative experience occurs in levels, with the individual moving from clearing cognitive "junk" (remnants of recent tasks), to recovering directed attention, then experiencing "cognitive quiet" (allowing for the resolution of more long term "cognitive residue" – "matters on one's mind that often go unheard" [p.197]), and finally leading to reflection. "A deeply restorative experience is likely to include reflections on one's life, on one's priorities and possibilities, on one's actions and one's goals" (Kaplan & Kaplan, 1989, p. 197).

It should be noted that, although popular – particularly among laypeople – to intertwine nature with Attention Restoration Theory, ART encompasses and explains more than experiences in response to the natural environment alone. Indeed, environments other than nature settings have been found to be restorative, including museums, monasteries, and houses of worship (Herzog, Ouellette, Rolens, & Koenigs 2010; Kaplan, Bardwell, & Slakter, 1993; Ouellette, Kaplan, & Kaplan, 2005). However, a limitation in the current body of restorative research is the inability to determine how participants are evaluating their environments.

Expanding Directions in ART Research

After S. Kaplan's 1995 synthesis, the debate largely ended in favor of his proposition, but the theory still needed support empirically. To this end, the years immediately following research into this area focused on testing attention restoration theory and/or using its tenets to develop other theories and measures. For instance, Tennessen and Cimprich (1995) expanded on the "view" work of Ulrich et al. (1984) by illustrating how more natural views from a college students' dormitory can positively influence attentional ability. Korpela and Hartig (1996) developed a rating system for potential restorative function of an environment called the Perceived Restorativeness Scale (PRS), which is based on Attention Restoration Theory, and illustrated that "favorite places" tend to be high in all four factors of ART. Herzog et al. (1997) expanded upon this by using the PRS to test how goal-sets influence the type of environments people seek, finding that nature, indeed, is a preferred setting for restoration from mental fatigue as well as an environment in which one can reflect. Kaplan (2001) discussed some of the limitations with the conceptualization of DAF and provided some evidence-based examples of ways to actively combat and recover from mental fatigue.

The progression of research studies citing and drawing from ART exploded in the early 21st century and largely followed the interests of the individual researcher. For example, several

studies have examined the restorative effects of gardening and its implications in therapy (de Bruin, Oosting, van der Zijpp, Enders-Slegers, & Schols, 2010; Gonzalez, Hartig, Patil, Martinsen, & Kirkevold, 2010, 2011; Hine, Peacock, & Pretty, 2008; Kiesling & Manning, 2010; Unruh, Smith, & Scammel, 2000). Some researchers have pursued ART from an urban design standpoint, finding that access to "green spaces" in urban environments mitigates levels of aggression (Cackowski & Nasar, 2003; Kuo & Sullivan, 2001; Parsons, Tassinary, Ulrich, Hebl, & Grossman-Alexander, 1998), enhances self-discipline in girls (Faber Taylor, Kuo, & Sullivan, 2002), improves coping with major life issues while promoting a more positive outlook among the impoverished (Kuo, 2001), and is an important factor in experiencing and managing stress (Stigsdotter et al., 2010) among other health outcomes (Brewer & Therrien, 2000; Cimprich & Ronis, 2003;Veitch, 2008). Additionally, there has been growing interest in how effective "virtual nature" is at eliciting the same effects seen in the physical natural environment (Hartmann & Apaolaza-Ibáñez, 2008, 2009; Kjellgren & Burkhall, 2010; Valtchanov & Ellard, 2010; Valtchanov, Barton, & Ellard, 2010) and the number of studies exploring ART as a basis or model for other therapeutic interventions, for example in individuals suffering from ADD/ADHD (Kuo & Faber Taylor, 2004; Faber Taylor, Kuo, & Sullivan, 2001; Faber Taylor & Kuo, 2009) or needing a mental break (Felsten, 2009; Fonara, 2009; Hartig & Staats, 2006; Staats, Kieviet, & Hartig, 2003; Staats, van Gemerden, & Hartig, 2010; Trougakos, Beal, Green, & Weiss, 2008), is almost too great to list completely (for a recent meta-analysis, see Annerstedt & Währborg, 2011). This is only a small sampling of ART-related research; yet despite the far-reaching implications of the theory, some central aspects remain unexplored.

When Hartig, Evans, Jamner, Davis, and Gärling (2003) had participants complete a number of attention depleting tasks and then spend time in either restorative (natural) environments or non-restorative (urban) environments, those participants who spent time in the

natural environments showed the greatest attentional recovery. During this study, researchers noted that efforts were made to prevent the directing of participants' attention during a 50-minute walk, stating specifically "caution was exercised to not direct subjects' attention in any way" (p.114), but there is no discussion regarding why these steps were taken. Presumably, the engagement of directed attention in this natural setting would constitute a "task" and, as the study relied upon pre-walk and post-walk tasks as a dependent variable, would therefore hinder the restoration elicited by that setting and skew the results. This can only be hypothesized, however, as no measurements were taken of participants' attention within the environments to determine what effect directing attention would have during exposure to a restorative environment. Likewise, Berto (2005), while having participants view images of restorative or non-restorative environments, specifically states participants "had only to look freely at the pictures, … no other tasks would be related to the picture content" (p.253). Berto (2007), in an investigation of high and low fascination environments, also directly states "task avoidance" in the directions to participants: "…you should look freely at the photographs, don't try to memorize any detail because this is not a memory task and no task related to the photograph contents will occur" (p.188). Kaplan and Kaplan (1989) offer some insight by means of a warning stating that "achieving [recovery] requires environments and tasks that make minimal demands on directed attention" (p.182), but this warning naturally raises the question: Would directing participants' attention in otherwise restorative environments in fact hinder the restorative function of these environments, as presupposed?

Whereas nature's attention-restoring facility is presumed to be a result of the non-directing and non-competing qualities of natural settings, directing attention in these environments should inhibit their restorative function. When directed attentional abilities are intentionally engaged during natural stimuli exposure we would expect a dramatic decrease in

attentional recovery to be observed. In contrast, the body of ART research suggests that urban settings are inherently demanding of our directed attentional abilities, therefore we would not expect a statistically significant difference when manipulating directed attention to urban stimuli.

In the current study I tested the critical assumption of ART: that the restorative facility of natural settings results from the lack of directed attention engagement as associated with the properties of soft-fascination, extent, compatibility, and being away. Participants were instructed to direct their attention while viewing a natural setting to see if recovery from DAF was still achieved.

Hypotheses

Given that natural environments are described as restorative to DAF largely as a result of their non-directing essence, I hypothesized that mentally fatigued participants would not experience directed attentional recovery when required to direct their attention while viewing natural stimuli. As seen in previous studies (e.g., Berto, 2005), participants free to evaluate natural settings were expected to exhibit the greatest attentional recovery from mental fatigue of the four groups as measured by scores on an attentional task. No hypotheses were made regarding the Directed-Urban group, as this element of directed attention has not been studied previously. However, given that urban environments are said to be less restorative than natural environments, the Directed-Urban group was informally expected to perform the worst of the four groups, although doubtfully significantly worse than the Free-Urban condition.

Perceived Restorativeness scores and positive and negative affects were expected to differ between groups. Specifically, given the pilot study that developed the stimuli, it is expected that participants in the nature conditions would rank their environments higher in perceived restorativeness as compared to the urban participants. Also, it was expected that nature

participants would report fewer negative and more positive affects than their urban counterparts, although it was unclear what effect directing attention would have on these factors.

Method

Participants

All 109 participants were undergraduate students at a medium-sized, Midwestern university, who completed the study for course/extra-credit in an undergraduate psychology class. Their mean age was 19.2 years (range 18-43). Most participants identified themselves as Caucasian (59.3%) or African-American (30.6%). Females were overrepresented in this sample (81.7%); and most participants were in their first (77.1%) or second (14.7%) year of college study. Participants described their current residence as being in a primarily urban (47.2%) area or an area with an even mix of urban and natural components (37.0%); a minority reported living in a primarily natural area (15.7%). As more recent studies have examined spiritual places as restorative environments (e.g., Ouellette, Kaplan, & Kaplan, 2005), participants were also asked to indicate their religious affiliation, if any. A summary of the demographic data and observed frequencies is provided in Table 1.

Measures

Two main measures were chosen for their ability to measure and deplete attention respectively: the Necker Cube Pattern Control Test (NCPCT; Cimprich, 1993) and the Sustained Attention to Response Test (SART; Robertson, Manly, Andrade, Beddeley, & Yiend, 1997). Additionally, the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) and Perceived Restorativeness Scale (PRS; Hartig, Korpela, Evans, & Gärling, 1996; Korpela & Hartig, 1996) were included in the questionnaire as additional measures of emotion and attitudes regarding the perceived restorative potential of the environments observed.

Necker Cube Pattern Control Test. The NCPCT has proven to be a reliable and valid measure of attention, virtually immune to practice effects (Cimprich, 1993). This test consists of a three-dimensional wire frame drawing of a cube that gives the illusion of depth while also being a reversible image. As the cube is viewed it will appear to spontaneously change orientation, with one particular face of the cube initially appearing to be towards the viewer or away from the viewer before reversals occur (Figure 1).

The NCPCT asks participants to initially allow the orientation shifts to occur during a 30 second trial, and to tap audibly on a board or recording device with each shift. Researchers record the number of taps made by each participant, thus establishing a baseline. After this initial phase, participants are asked to prevent the orientation shifts as much as possible during another 30 second trial. Orientation reversals are inevitable, even when actively attempting to prevent them, but the difference between reversals in the free condition versus the active inhibition condition gives a measure of an individual's capacity for directed attention. The numerical result of this test is the percentage of reduction in reversals that occur from the baseline trial to the active inhibition trial. In the current study, the NCPCT was computerized and the "taps" were recorded by the participants' pressing of a response key.

SART-10. The second test used was the Sustained Attention to Response Test (SART; Robertson et al., 1997). The SART has been used in environmental studies as an additional measure of attention as well as to deplete directed attention. The SART-10 is a modified version presented via computer that asks participants to view a sequence of randomized digits (one to nine) and respond to all but the target stimulus (the number "3"). Two-hundred forty digits were displayed with each remaining on the screen for 250 milliseconds with a 1125 millisecond delay between the digits. Ten percent of the digits were "target objects"; reaction times and correctness were recorded. The effort involved in attending to every stimulus and inhibiting response to the

target stimulus is believed to be very cognitively demanding (Berto, 2005). Scores were not calculated for the SART trial as its only function was to induce fatigue and the measure was not repeated.

Questionnaire. The questionnaire consisted of 48 questions in three parts: (1) general demographics and manipulation checks, (2) the Perceived Restorativeness Scale (PRS), and the (3) Positive and Negative Affect Schedule (PANAS) (see Appendix A). The general demographics section contained basic questions regarding participant age, sex, and ethnicity, as well as questions regarding religiosity, type of current residence (e.g., natural or urban), and the type of environment they were shown that day as part of the experiment. This section concluded with two manipulation checks where participants were shown randomly selected quarters of images: there were 48 quarters with four from each of the Nature images, four from each Urban image, and four each from two distractor images, one of a natural environment and one of an urban environment. Participants were then given the opportunity to describe the environments they viewed during the experiment with a free-text section that asked them to "write as much detail as you can about the environments you just saw in the experiment" from which a simple word-count was calculated.

The second section of the questionnaire consisted of the PRS. Participants were asked to think back to the environment shown to them during the experiment and answer questions relating to those stimuli. The PRS measures perception of the restorative potential of an environment by asking participants to answer questions from the four ART dimensions such as "Being here is an escape experience," or "My attention is drawn to many interesting things." Participants were asked to rate those and similar statements on a 7-point scale, with "0" representing "completely disagree" and 6 representing "completely agree" (see Appendix A).

The Extent subscale contains negatively worded items, so it was reverse scored as described in Han (2003).

The final section of the questionnaire consisted of the PANAS. The PANAS presents participants with a list of 20 words (affects such as “interested”, “upset”, “alert”, etc.). Participants indicated the extent to which they experienced the affects in the past week on a 5-point scale ranging from “very slightly or not at all” to “extremely.” The inclusion of an affective measure allowed for evaluation of participant mood states, which is necessary given that mood has been shown to influence attentional ability (Tennessen & Cimprich, 1995).

Reliability testing was conducted on all scales. Cronbach’s alpha tests of reliability revealed good internal consistency for both PANAS measures (Positive PANAS $\alpha = .87$; Negative $\alpha = .85$) and excellent internal consistency for the PRS measure, $\alpha = .90$.

Stimuli. The visual stimuli used in this experiment were developed from peer ratings. All images were taken at the same time of day under equivalent weather conditions during a two-week period in the fall of 2007. These images were then shown to 83 undergraduate students at Indiana State University, where the present study took place. Pilot participants were shown 20 color slides, 10 each of urban and natural images, and were asked to rate the images on a 6-point Likert-type scale according to typicality with 1 being “Very Atypical” and 6 being “Very Typical” of subjective interpretations of nature and urban settings. The five natural and urban images rated as most “typical” were selected for inclusion in the study (see Appendix A for samples). No significant differences existed between the most typical nature and urban images, $t(79) = 0.00$, $p=.23$, but significant differences were apparent between the typical and atypical natural stimuli, $t(79) = 6.48$, $p<.001$, and the typical and atypical urban stimuli, $t(79) = 6.71$, $p<.001$.

Procedure

After completing a consent form and receiving basic procedural instructions, participants experienced a computerized NCPCT to obtain an initial measure of their directed attentional ability. Following the test, participants completed a practice SART-10 trial followed by the actual 5.5 minute SART-10 (to induce DAF) and then another NCPCT. As noted earlier, the SART-10 has proven to fatigue directed attention, so by following this test with a second NCPCT administration and comparing scores to the initial administration, fatigue could be quantified.

A standard 2-by-2 experimental design was used in this study, manipulating whether or not participants engaged directed attention when viewing urban or natural stimuli. Similar to Berto (2005), in each condition participants viewed five images of one type of environment, either natural or urban (built), for 60 seconds each and presented as color slides on a 17-inch monitor with a refresh rate of 60 Hz at a quality of 800-by-600 dpi. The images were viewed at a distance of approximately three feet in a dimly lit room to encourage gaze only on the stimuli. All images used were presented randomly from the stimulus set developed in pre-test groups mentioned earlier.

Participants differed in regards to the engagement of directed attention and the type of environments viewed. Each participant viewed only one type of environment (natural or built) and experienced only one set of instructions. In total, 109 participants were recruited and were block randomized to ensure an even number in each condition. Initially, only 80 participants were expected to participate, but issues with the computerized administration of the NCPCT necessitated extending that invitation. At study completion, 28 participants had completed the Directed-Nature program version, 26 were Free-Nature participants, 26 had gone through the Directed-Urban program, and 29 were Free-Urban randomized.

After viewing the slides, participants completed one last NCPCT to measure recovery from fatigue, followed by a brief online questionnaire. Participants were debriefed regarding the purpose of the study and then left the laboratory.

One of the greatest challenges in this experimental design was to prove the use of a mental resource, which is necessary to evaluate the Attention factor. To accomplish this end, participants in the directed conditions were told that questions would follow regarding the environments they were about to view. They were instructed to pay careful attention to the images. As all participants were asked to describe the environments they viewed, an analysis of responses was performed to check this manipulation. It was expected that participants who were told they would later be questioned about the environments would write longer responses and more accurately describe the various environments viewed. This was measured through a simple word count as well as a picture matching section. For the picture (environment) matching, sections of the environments presented to participants were displayed along with sections of environments not shown and two distractor environments. Participants were asked to indicate which environments they were shown during the experiment by checking a box next to that image section.

Results

The primary dependent variable of interest in this study was the change in NCPCT scores across the recovery period (i.e., from before viewing the environment slides to immediately after the slides). However, due to apparent issues with computerized administration and instructions, some raw response counts were eliminated prior to analysis.

Outliers and Indeterminate Scores

The frequency distribution of all response counts was plotted to identify outliers (see Figure 2). NCPCT “raw” scores were the simple count of responses to orientation shifts. It was

evident both during the experiment and in reviewing the data that participants had difficulty understanding the NCPC task with response counts ranging from 0-579. To put this in context, a pilot study with two participants of similar age to the sample was completed wherein participants were asked to press a response key "as fast as possible" for a period of 30 seconds (the same time length as one NCPCT trial). Three trials per participant were completed with a mean of 205.33 (range 189-240). Given this data, I chose to use three standard deviations as the cutoff for outliers (SD = 76.94) or 230.83 responses. Raw response scores at and above this level were likely the cause of participants continuously holding the response key as opposed to a single press per orientation shift. Of the 654 individual response counts (three time points; two response periods/counts per time point for 109 participants), this process excluded 11 of those, leaving 643 response counts to use for NCPCT scoring. Also, several participants recorded either no "free" orientation shifts, or more orientation shifts in the "hold" or inhibition trials than the free-shift trials, making the resulting percentage reduction calculation an indeterminate. Nineteen indeterminates were excluded from analyses, leaving 90 percentage reduction scores that indicated the recovery from fatigue from before to after viewing the slides

Manipulation Check

Along with the environmental matching (image quarters) and word counts, participants were asked what type of environment they were shown and, if they were told to "pay attention", did they do so. Unexpectedly, the number of recall errors were greater in the directed versus free groups, with Free-Nature participants making 1 matching error (3.8%) and no errors of environment identification; and Free-Urban participants making 2 matching errors (6.9%) and 1 error in identifying the environment shown (3.5%). Conversely, participants in the Directed-Nature condition made 3 matching errors (10.7%) and 1 error in identifying the environment shown (3.6%) versus 6 matching errors (23.1%) and 2 environmental identification errors (7.7%)

for the Directed-Urban participants. These differences were not statistically significant, but it should be noted that the frequencies were too small for the analysis to be considered wholly reliable (Yates, Moore, & McCabe, 1999). Also, questioning participants about their engagement of attention proved to be a flawed method in that the majority of participants (94.44%) indicated they were instructed to "pay attention" regardless of experimental condition, so this metric was not explored further.

However, word counts were analyzed by condition through one-way analysis of variance (ANOVA) and a significant difference was found between groups in words written about the environment, $F(3, 105) = 3.663$, $p = .015$. Specifically, participants in the Urban groups wrote more words about their environments ($M = 49.95$, $SD = 34.48$) than participants in the nature groups ($M = 32.80$, $SD = 25.71$), with Directed-Urban participants using the most words to describe the environments they viewed ($M = 52.46$, $SD = 31.96$), a difference that was only significant when compared to the Directed-Nature participants ($M = 27.18$, $SD = 21.36$), $t(105) = 3.05$, $p = .003$. Free-Nature participants wrote less than either of the urban groups, but not significantly more than Directed-Nature participants ($M = 38.85$, $SD = 28.9$), $t(105) = 1.41$, $p = .162$. Although Free-Urban participants wrote more words on average than participants in either of the nature conditions ($M = 47.69$, $SD = 37.01$), this difference was not significant when compared directly to the Free-Nature participants, $t(105) = 1.08$, $p=.28$, nor did Free-Urban participants use significantly less words to describe the environments than Directed-Urban participants, $t(105) = .58$, $p = .56$. Free-Urban participants were not directly contrasted with Directed-Nature participants as the equivalency between any cognitive task and the free evaluation of a nonrestorative environment remains unclear.

Gender and Residence were independently included as potential covariates in 2-by-4 ANOVA on magnitude scores, but there was no significant effect of participant gender on

magnitude scores, F (1, 70) = .001, p = .98, and no significant interaction of Gender and condition, F (3, 70) = .39, p = .76. Likewise, the type of environment in which participants primarily resided, (rural, urban, or an even mix of those), did not significantly affect recovery from DAF, F (2, 70) = .30, p = .74, and no interaction between residence type and experimental condition was found, F (6, 70) = .51, p = .80, so Gender and Residence were excluded from further analyses.

Hypothesis Testing

Since directed attention was measured using the Necker Cube Pattern Control Test (NCPCT), whose resulting score is the difference in free versus held orientation image reversals, a score of 1.00 indicated a perfect capacity to direct attention, whereas a score of 0.00 indicated no directed attention capacity for that administration. Additionally, since I was interested in the change in this capacity across the intervention, NCPCT scores prior to environmental viewing were subtracted from the NCPCT scores immediately after exposure to the environment, so positive scores indicated an increased capacity to direct attention, and negative scores indicated that directed attention capacity decreased (i.e., increased directed attention fatigue). Free-Nature participants exhibited the greatest recovery from directed attention fatigue (M = .55, SD = 1.95), followed by Free-Urban participants (M = .07, SD = .64), Directed-Urban participants (M = -.17, SD = 1.50), and finally with Directed-Nature participants exhibiting the least recovery of any group (M = -.41, SD = 1.41). One-way ANOVA was conducted to test for differences on NCPCT gain scores between the four experimental conditions and no significant difference was observed, F(3, 86) = 1.780, p = .157. Contrast testing was used to test the a priori hypothesis that the engagement of directed attention significantly inhibits recovery from fatigue in participants viewing restorative settings; tests were also conducted to compare recovery in the “free”

restorative and urban groups, a difference repeatedly shown in the literature, and between the "free" and "directed" urban group, although only a weak hypothesis was offered.

As predicted, participants allowed to freely evaluate restorative environments experienced significantly greater recovery from fatigue than those viewing these same environments but who were instructed to direct their attention, $t(86) = 2.21$, $p = .03$. Not surprisingly, given the non-significant omnibus test, this was the only significant finding. No statistically significant differences in restoration were found between the "free" and "directed" urban conditions, $t(86) = .58$, $p = .57$, or between the Free-Nature and Free-Urban conditions, $t(86) = 1.14$, $p = .26$.

Additional Analyses

Positive and negative PANAS scores were analyzed using one-way ANOVA to investigate group differences. As seen in Table 2, contrary to expectations, participants viewing urban images reported experiencing less negative affect than participants in the nature groups although this difference was not statistically significant, $F(3, 105) = 1.722$, $p = .167$. However, consistent with expectations, nature groups reported greater positive affect, though again, this difference was not statistically significant, $F(3, 105) = .757$, $p = .52$.

Mean Perceived Restorativeness Scale (PRS) subscale scores as well as correlations among the subscales are reported in Table 3. Multivariate ANOVA was conducted to compare the perceived restorative properties of the environments. The results revealed a statistically significant difference in perceived restorativeness based on condition, $F(12, 270) = 10.64$, $p < .001$. Univariate tests revealed that environment level had a statistically significant effect on the PRS subscales "Being Away"($F(3, 105) = 22.98$, $p < .001$) and "Extent" ($F(3,105) = 39.95$, $p < .001$) specifically, with those in the nature groups reporting their viewed environments had greater perceived compatibility with these components than participants in the Urban groups. No

statistically significant differences were observed in the "Fascination", $F(3, 105) = 1.08$, $p = .36$, or "Compatibility", $F(3,105) = 1.34$, $p = .27$, subscales, indicating that participants viewing urban images did not rate these environments as higher in fascination or compatibility than those viewing natural images.

Discussion

This study attempted to address the role of tasks in recovery from directed attention fatigue, as well as inform the general design process of ART research. Participants viewing "restorative" or natural environments who were told they would later be questioned about the environments they viewed exhibited not only less recovery from fatigue, but even increased fatigue when compared to participants asked to evaluate their environments freely. This suggests that the simple task of being asked to pay attention when evaluating environments is fatiguing in itself, likely due to the condition of having to inhibit subjective goals in favor of satisfying the task at hand (as noted by Yarbus, 1967). This difference in fatigue was particularly prominent in participants shown images of natural environments.

While those who were "free" to view the nature scenes showed the expected pattern of "recovery" from DAF, this same difference was not statistically significant in the groups shown built environments. It is nonetheless worth noting that the introduction of a task still created a situation where fatigue appeared to increase, which could be considered practically significant. In real-world encounters with urban environments, we are often carrying out tasks such as wayfinding even if a task has not been directly assigned. Given the results, then, it is likely after a mentally taxing day at work that taking the routine route to a favorite restaurant would find the traveler in a more restored state upon arrival than if an alternative route or detour requiring continued attention were necessary, all else being equal. In fact, the data suggest the latter option is likely to leave the traveler more fatigued than when they left the office.

Historically, research into ART has often compared recovery from fatigue following exposure to natural and built environments, and found that natural environments facilitate cognitive recovery whereas urban settings seem inhibitory or, at least, "neutral" (e.g. Hartig, Evans, Jamner, Davis, & Gärling, 2003; Laumann, Gärling, & Stormark, 2003; Berto 2005, Berto, Baroni, Zainaghi, & Bettella, 2010; Valtchanov, Barton, & Ellard, 2010). Although not achieving significance, these results were replicated in the present study. Of particular interest, however, was the ordering of restoration/increased fatigue. Participants allowed to freely evaluate the environments were expected to experience the greatest recovery from DAF, with those viewing natural environments exhibiting the most recovery, which is indeed the finding. However, no a priori hypotheses were made to predict whether urban environments are so demanding of our attention inherently that a difference would be found when a task was introduced.

As noted previously, participants with a task and shown natural environments exhibited increases in fatigue even greater than those of participants shown urban environments. A possible explanation would be in the suggestion that urban environments are "neutral" in terms of their effect on DAF, whereas natural environments are said to be actively restorative (Valtchanov, Barton, & Ellard, 2010). Again, soft fascination is defined by environments that contain the correct mix of interesting yet not intensely engaging qualities, as is often the case with natural environments. However, when given a general memory task or being asked to pay attention to these environments, the goal objects are less clear, and indeed, participants viewing restorative environments have exhibited fewer fixations compared to their non-restorative counterparts (Berto 2008). Urban environments typically contain a number of wayfinding and advisory signals and signage, as well as unique objects that capture attention. Natural environments tend to lack these features, so introducing a recall task when viewing these

environments likely leaves participants searching for goal objects, which greatly increases fixations. In the present study, there was likely confusion about the questions to be asked of natural environments: “Should I count the number of trees; the clouds in the sky; the blades of grass?”, whereas the urban environments contained more distinct objects about which one would expect to be questioned: “How many cars are there? What color was the traffic signal?” This would lead to a situation where more directed attention is required in evaluating the natural scenes than the urban scenes, but further study is needed to support or refute these hypotheses, although they are somewhat supported by the word count data.

Participants in urban conditions wrote significantly more words on average, regardless of attention level, compared to those viewing natural environments, with Directed-Urban participants writing the most of any group. While the presence of goal objects in urban environments is likely a main contributing factor to this finding, of equal likelihood is a lack of vocabulary and perception with which to describe natural environments. As expressed by Yi Fu Tuan, “we notice bushes, trees, and grass, but rarely the individual leaves and blades; we see sand but not its individual grains” (pp. 14-15, *Topophilia*). It seems, in reverse of the adage, we often do not see the trees for the forest, and this is a key quality of the soft fascination component of restorative environments. Truly, the shortest response from the nature groups supports this suggestion, with the author simply stating: “I saw trees, river, forest.” Also, while not analyzed, participants’ descriptions of natural environments contained more qualitative words like “sunny” and “reflective shadows” (present in both environments), as well as affective words like “serene”, “nice”, “beautiful”, and “peaceful”. Both sets of images were taken at approximately the same time of day, but urban groups tended to describe cars, streetlights, parking meters, and signage as opposed to the sky and lighting conditions, even though these were clearly visible in all images.

It is interesting that participants viewing urban images, particularly those asked to direct their attention to these environments reported less negative affects than those in the nature conditions. The sample was overrepresented in those listing urban environments or an even mix of urban and rural environments as their place of residence. Therefore, urban images could have presented pictures of "home" and elicited more positive affects (or, at least, decreased reporting of negative affects) because of this effect. Also, the study was conducted during one of the worst winters the area had seen in many decades. The natural images, depicting green grass and sunshine, could easily have created a sense of longing or even disdain in participants viewing those environments. Unfortunately, we still are not able to determine how participants are processing the environments viewed, so these effects are only subject to speculation at this point.

Limitations

Even though the data support the primary a priori hypothesis, several limitations must be noted. First, electronic administration of the NCPCT does not seem to be the ideal method, given the confusion exhibited by several participants. Future studies should either revert to classic methods of administration (e.g., counting taps on a board), or spend more time ensuring participants' understanding of reversible images prior to the trials and blocks of interest. Also, the resulting significant effects on fatigue and the word count data clearly suggest that a manipulation did occur even though built-in checks were unsuccessful at supporting its presence. Furthermore, participants only experienced one administration of the SART-10, making the fatigue experienced rather small and the effect small by association. Similar studies should continue to utilize multiple SART administrations or a battery of fatiguing tasks to ensure more confidence in experimental results. Additionally, participants identifying as "female" and "Christian" were overrepresented in the sample, making the results somewhat limited in terms of external validity. In the same vein, the images shown to participants were chosen to represent

"everyday" nature and urban settings to a primarily Midwest sample. Because of this, participants not intimately familiar with the Midwest might respond differently to scenes closer to their prototypes of everyday natural and urban environments.

Future Directions

This study supports the efforts of past researchers in reducing or eliminating tasks when evaluating exposure to restorative environments. As ART research continues to be aided by technology that allows for more "real-life" experiments and field studies (e.g., Aspinall, Mavros, Coyne, & Roe, 2013), it is important to note that some tasks will be unavoidable in natural settings, but it is still worthwhile to control for these where possible, particularly given their effect in restorative settings. Also, these findings support the suggestion that commonplace natural environments are actively restorative and urban environments, likely, neutral in the absence of real or perceived threats. However, it was unexpected for stimuli chosen because of its representativeness of natural environments to only significantly differ from urban environments on two of the four PRS subscales. Apart from the limitations and external conditions discussed previously, perhaps Being Away and Extent are more restorative to the restorative experience than Compatibility and Fascination, the latter of which is often said to be the greatest contributing factor in recovery. Further research is needed for continued understanding of each component's contributions to the restorative process.

While restorative environments and their effect on directed attention fatigue have been studied in depth, non-restorative environments have largely been described in antithetical terms, simply lacking those restorative qualities. As already suggested by Valtchanov, Barton, and Ellard (2010), additional exploration is needed into the specific components of non-restorative environments to determine their neutral or fatiguing qualities. Such findings would not only aid

those seeking restoration from fatigue, but would also provide evidence-based suggestions to designers of public and private built environments.

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Table 1

Demographics

Characteristic	*N* (Range)	%
Gender		
Male	20	18.3
Female	89	81.7
Age	19 (18-43)	
Ethnicity		
African American	33	30.6
Caucasian	64	59.3
Hispanic	4	3.7
Other or Multiple Ethnicities	7	6.4
Marital Status		
Single, never married	101	93.5
Married	2	1.9
Living with a partner	4	3.7
Separated	1	0.9
Year of Study		
Freshman	84	77.1
Sophomore	16	14.7
Junior	4	3.7
Senior	2	1.8
"+4 years"	3	2.8
Religious Affiliation[a]		
Atheist	1	0.9
Blank/NA/None	35	32.1
Christian/Catholic	68	62.4
Muslim	3	2.8
"Spiritual"	2	1.8
Religious Attendance		
Multiple times per week	5	4.8
Weekly meetings (once)	15	14.4
Multiple times per month	17	16.3
Monthly meetings (once)	3	2.9
Multiple times per year	15	14.4
A few select times per year	22	21.2
Not applicable/I don't attend	27	26.0
Current Residence		
Natural	17	15.7
Urban	51	47.2
Even mix	40	37.1

[a] Open Question (Free Text)

Table 2

Mean scores on the Positive and Negative Affect Schedule (PANAS) and Perceived Restorativeness Scale (PRS) by condition

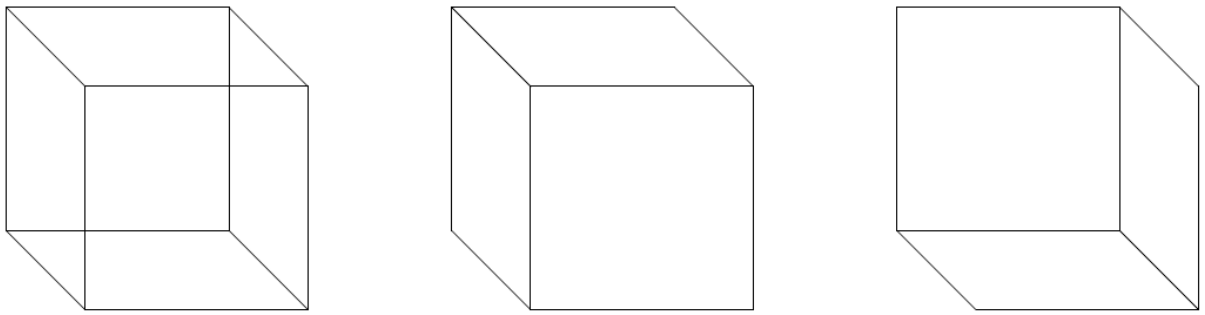
Condition		Positive		Negative		Being Away		Fascination		Extent		Compatibility	
	N	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Free-Nature	26	31.77	7.54	23.00	8.67	16.73	3.28	18.96	5.83	17.77	2.52	21.73	6.66
Directed-Nature	28	33.18	8.41	24.89	8.39	16.04	4.13	19.75	5.61	18.18	2.83	24.39	7.60
Free-Urban	29	30.28	7.69	22.07	7.08	9.59	4.29	17.38	4.53	10.76	3.60	21.10	5.77
Directed-Urban	26	32.73	7.74	20.31	5.78	10.69	4.09	19.08	4.53	10.96	4.37	22.31	5.97

Table 3

Descriptive statistics and correlations of Perceived Restorativeness Scale (PRS) subscales

PRS Subscale	M	SD	1	2	3
1. Being Away	13.21	5.05			
2. Fascination	18.77	5.16	0.44**		
3. Extent	14.39	4.91	0.59**	0.01	
4. Compatibility	22.39	6.57	0.50**	0.70**	0.15

Notes: **p<.01; N=109



Necker Cube Possible Orientation 1 Possible Orientation 2

Figure 1. Possible orientations of the Necker Cube.

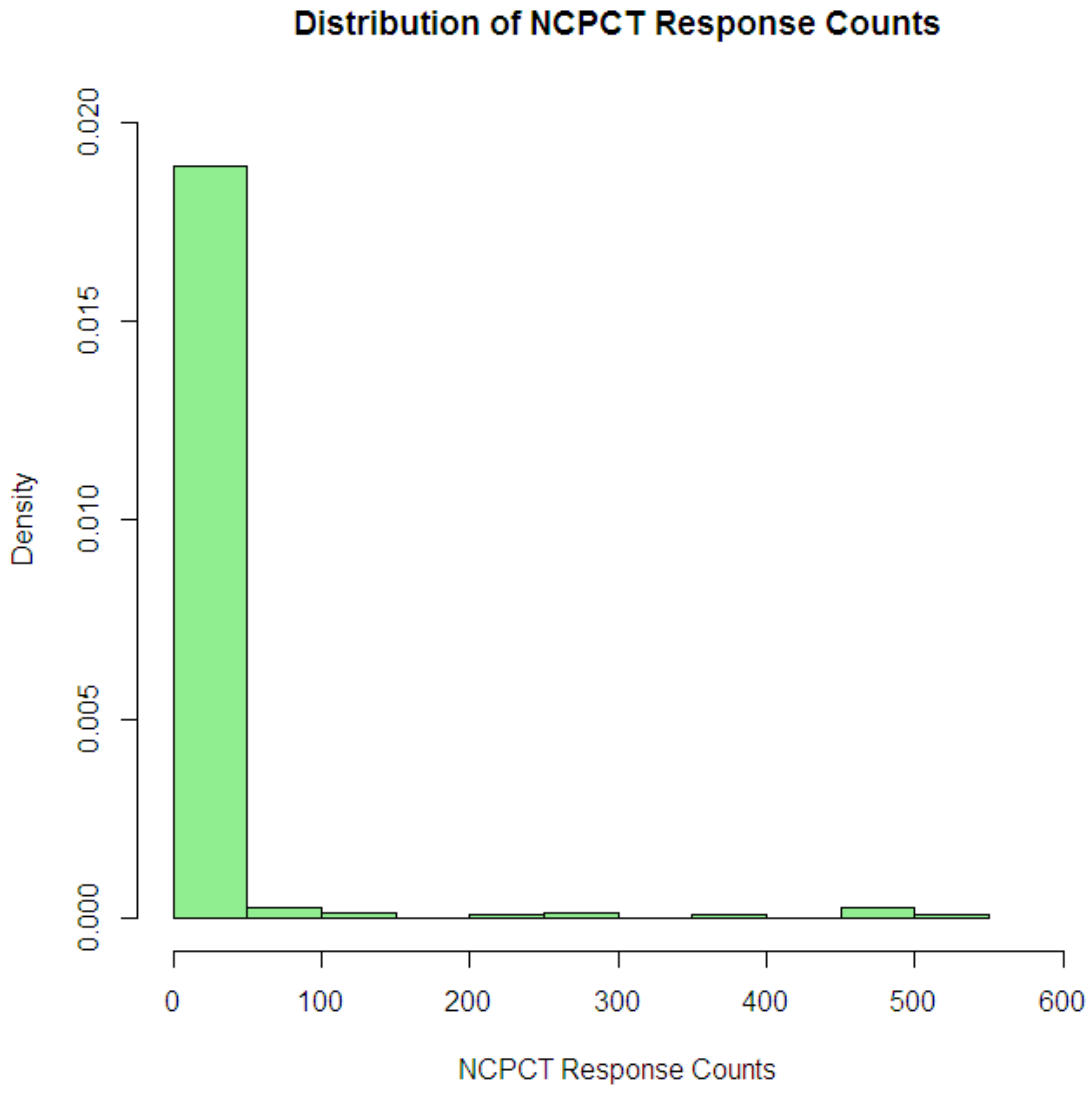


Figure 2. Plot of distribution of Necker Cube pattern control test responses.

APPENDIX A: QUESTIONNAIRE

Intro Block

What is your Participant Number?

What is your gender?

- Male
- Female

What is your current age? (example: 20)

How would you describe yourself?

- African American
- Asian
- Caucasian
- Hispanic
- Native American or Alaskan Native
- Pacific Islander
- Other or Multiple Ethnicities
- Prefer no to answer

What is your marital status?

- Single, never married
- Married
- Living with a partner
- Separated
- Divorced
- Widowed

What is your year of study?

- Freshman (first-year)
- Sophomore
- Junior
- Senior
- +4 Years

Please indicate your religious affiliation, if any.

If you attend religious services, how often do you attend?

- Multiple times per week
- Weekly meetings (once)
- Multiple times per month
- Monthly meetings (once)
- Multiple times per year
- A few select times per year
- Not applicable/ I don't attend

Please choose the description that best fits your current residence.

- Completely natural surroundings/Rural
- Mostly natural surroundings
- An even mix of natural and built surroundings
- Mostly built surroundings
- Completely built surroundings/urban

Thinking back to the slides you saw, what type of environment did you view?

- Nature
- Urban

If you were told to pay careful attention to the environment you viewed, did you do so?

- Yes
- No
- Not Applicable

Environment Matching

Please look carefully at each image below. These are sections of larger images. Some sections might not be from the images you just viewed in the experiment.

Please check the box next to any sections that ARE from the images you viewed.


OFFICE
SPACE
FOR LEASE
964-0000

Environment Recall

In your own words and without looking back at the image sections, please write as much detail as you can about the environments you just saw in the experiment.

PRS

For these next questions, you will need to think back to the enviornment you were shown and answer the questions as if you were actually in that environment. You will make your responses using a 7-point scale to indicate the degree to which you agree or disagree with the statement (0 = Completely disagree; 6 = Completely agree). Indicate your response by clicking the choice that corresponds to your attitude.

Being here is an escape experience.

0 Completely disagree	1 Mostly disagree	2 Somewhat disagree	3 Neither agree nor disagree	4 Somewhat agree	5 Mostly agree	6 Completely agree
○	○	○	○	○	○	○

Spending time here gives me a break from my day-to-day routine.

0 Completely disagree	1 Mostly disagree	2 Somewhat disagree	3 Neither agree nor disagree	4 Somewhat agree	5 Mostly agree	6 Completely agree
O	O	O	O	O	O	O

It is a palce to get away from it all.

0 Completely disagree	1 Mostly disagree	2 Somewhat disagree	3 Neither agree nor disagree	4 Somewhat agree	5 Mostly agree	6 Completely agree
O	O	O	O	O	O	O

This place has fascinating qualities.

0 Completely disagree	1 Mostly disagree	2 Somewhat disagree	3 Neither agree nor disagree	4 Somewhat agree	5 Mostly agree	6 Completely agree
O	O	O	O	O	O	O

My attention is drawn to many interesting things.

0 Completely disagree	1 Mostly disagree	2 Somewhat disagree	3 Neither agree nor disagree	4 Somewhat agree	5 Mostly agree	6 Completely agree
O	O	O	O	O	O	O

I want to get to know this place better.

0 Completely disagree	1 Mostly disagree	2 Somewhat disagree	3 Neither agree nor disagree	4 Somewhat agree	5 Mostly agree	6 Completely agree
O	O	O	O	O	O	O

The setting is fascinating.

0 Completely disagree	1 Mostly disagree	2 Somewhat disagree	3 Neither agree nor disagree	4 Somewhat agree	5 Mostly agree	6 Completely agree
O	O	O	O	O	O	O

It is a confusing place.

0 Completely disagree	1 Mostly disagree	2 Somewhat disagree	3 Neither agree nor disagree	4 Somewhat agree	5 Mostly agree	6 Completely agree
O	O	O	O	O	O	O

There is a great deal of distraction.

0 Completely disagree	1 Mostly disagree	2 Somewhat disagree	3 Neither agree nor disagree	4 Somewhat agree	5 Mostly agree	6 Completely agree
O	O	O	O	O	O	O

It is chaotic here.

0 Completely disagree	1 Mostly disagree	2 Somewhat disagree	3 Neither agree nor disagree	4 Somewhat agree	5 Mostly agree	6 Completely agree
O	O	O	O	O	O	O

Being here suits my personality.

0 Completely disagree	1 Mostly disagree	2 Somewhat disagree	3 Neither agree nor disagree	4 Somewhat agree	5 Mostly agree	6 Completely agree
O	O	O	O	O	O	O

I can do things I like here.

0 Completely disagree	1 Mostly disagree	2 Somewhat disagree	3 Neither agree nor disagree	4 Somewhat agree	5 Mostly agree	6 Completely agree
O	O	O	O	O	O	O

I have a sense that I belong here.

0 Completely disagree	1 Mostly disagree	2 Somewhat disagree	3 Neither agree nor disagree	4 Somewhat agree	5 Mostly agree	6 Completely agree
O	O	O	O	O	O	O

I can find ways to enjoy myself here.

0 Completely disagree	1 Mostly disagree	2 Somewhat disagree	3 Neither agree nor disagree	4 Somewhat agree	5 Mostly agree	6 Completely agree
O	O	O	O	O	O	O

I have a sense of oneness with this setting.

0 Completely disagree	1 Mostly disagree	2 Somewhat disagree	3 Neither agree nor disagree	4 Somewhat agree	5 Mostly agree	6 Completely agree
O	O	O	O	O	O	O

Panas

The scale below consists of a number of words that describe different feelings and emotions. Please read each item and then click the appropriate answer next to that word. Indicate to what extent you have felt this way during the past week by clicking the corresponding choice.

	Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
Interested	O	O	O	O	O
Distressed	O	O	O	O	O
Excited	O	O	O	O	O
Upset	O	O	O	O	O

Strong	O	O	O	O	O
Guilty	O	O	O	O	O
Scared	O	O	O	O	O
Hostile	O	O	O	O	O
Enthusiastic	O	O	O	O	O
Proud	O	O	O	O	O
Irritable	O	O	O	O	O
Alert	O	O	O	O	O
Ashamed	O	O	O	O	O
Inspired	O	O	O	O	O
Nervous	O	O	O	O	O
Determined	O	O	O	O	O
Attentive	O	O	O	O	O
Jittery	O	O	O	O	O
Active	O	O	O	O	O
Afraid	O	O	O	O	O